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ABSTRACT

This technical memorandum presents an outline of how to apply psycholinguistic and intellective concepts in order to enhance the readability and comprehensibility of written materials. Guidelines for making the reader's task easier are provided, and some readability measurement procedures are also discussed. The contents include: "Increasing Readability/Comprehensibility," which discusses morphemes, sentence voice problems, negativity problems, self-embedding, depth, complements, and branching; "Helping the Reader's Intelligence to Work Easily," which looks at deemphasizing vocabulary diversity, seeing generalizations, cutting down unnecessary details in figures and diagrams, repeating facts for the reader, organizing the material, and avoiding abbreviations: and "Measuring Readability," which discusses the use test, the comprehension test, rating by experts, the cloze procedure, element counting techniques, and more details on readability measures. (WR)

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TECHNIQUES FOR MAKING WRITTEN MATERIAL MORE READABLE/COMPREHENSIBLE

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CHAPTER I

INCREASING READABILITY/COMPREHENSIBILITY

Introduction

The purpose of these ***Techniques for Making Written Material More Readable/Comprehensible*** is to improve the capability of Air Force training manuals, texts, and other written materials to transfer information to the intended readers.

The person who will profit the most (if the suggestions we lay down here are followed) is the person who must read, comprehend, and apply the written information which you write. This manual was prepared to help technical writers and others who write training texts and other student materials to write them so that readers will have an easier time.

Basically, any situation which requires reading comprehension also requires learning. That is, a reading situation is also a learning situation. The reader may not be required to learn the reading passage or book totally, but he is required to remember the concepts, facts, relationships, and implications presented in the reading. According to Gagné (1965), learning is a change in human capacity not dependent upon maturation or growth. "The kind of change called learning exhibits itself as a change in behavior, and the inference of learning is made by comparing what behavior was made possible before the individual was placed in a 'learning situation' and what behavior can be exhibited after such treatment. The change may be, and often is, an increased capability for some type of performance" [p. 5]. The definition given by Gagné corresponds precisely to a description of an individual prior to and after he reads textual material.

Until now, people who were interested in the question of how to make written materials more readable concerned themselves with analyzing materials that were already written, in terms of frequency of common words, word length, sentence length, etc. (e. g., Flesch, 1943; Dale & Chall, 1948). These approaches have not proven to be entirely adequate for making materials more readable. We will make no use of them here. Neither are we interested in teaching what has been

called by these prior persons "effective writing" (e. g., Flesch, 1943, 1946, 1949; Grey & Leary, 1935). We are, however, interested in applying the findings from modern scientific research relative to how certain kinds of written materials impose a heavy load on a reader's mind. On the basis of these findings, we can tell a writer how to avoid placing a heavy mental load on his reader and thus, at the same time, make his written material more understandable.

In the past year, Applied Psychological Services, under contract to the Air Force Human Resources Laboratory, has conducted research into what makes written material more understandable. We studied this problem from two approaches. One approach looked into the question of how human intelligence works during reading--if we know how it works, we can manipulate written material so that it allows the intelligence to work as well as possible and thus make the material easier to understand. The second approach looked into the question of how some written materials place a heavy mental load on a reader. If we can answer this question, we can tell writers how to avoid using materials that impose such heavy mental loads on a reader, and thus make the material more readable.

It is from the findings of these two research approaches that we will try to give you some tips on how to write material that is more readable. The end result will be a written text from which the reader learns more from the same amount of time investment on his part.

Morphemes

In much of the older research on readability, we find the suggestion that, to make reading matter more understandable, we should avoid long words. One of the most important findings which came out of the research on the mental load imposed on the reader by various types of textual material was that the length of the words themselves does not matter too much. What matters is how many things called "morphemes" make up the word. A morpheme may be a whole word itself, or it may be a "little word" inside a bigger word. Let us explain this briefly. The word "rose" is a single morpheme--it is an individual unit of meaning or learning. The word "means" something all by itself. Now, look at the word "unhappiness." It too is a word, but inside it are three "little words," "un"--which means not, "happi" --which refers to an emotional state, and "ness"--which refers to

the fact that something is in a particular state, condition, or quality. The whole word "unhappiness" means that someone is not in the state of being happy. It contains three morphemes packed into one word.

The research demonstrated that when a piece of reading material contained words that consisted of a lot of these morphemes (in little words), it was much harder to understand than was a similar piece of reading matter that contained fewer morphemes. This tells us that when we write, we should choose our words so that we say what we want to say with words that contain as <u>few</u> morphemes as possible. Take the following sentence: "The boy was sick because of his unhappiness." Most readers would understand it more easily if we wrote: "The boy is sick because he is not happy."

Assume that you are writing a manual for a mechanic's job. Rather than use the phrase "Disassemble the interconnecting linkage" you should write "Take apart the interconnecting linkage." Here, we have employed fewer morphemes.

As a second example, take the following paragraph on the mouth-to-mouth method of artificial respiration (which we might better call "breathing for another person"):

> In this method you breathe air into the victim's lungs with your own mouth. Since you consume only part of the oxygen out of the air you inhale, the air you breathe into the victim's lungs contains enough oxygen to revive him (from AF student text 3AQR30030).

Most students would learn more easily from the text, if we changed it to read:

> In this method you breathe air into the victim's lungs with your own mouth. Since you use only part of the oxygen out of the air which you breathe in, the air you breathe into the victim's lungs has enough oxygen to bring him back.

Just by making these few changes, we have increased the paragraph's readability/comprehensibility without altering the content.

As a writer, your job is to give other people the know-how that you have; you can do this best by using words with only a few morphemes. The thoughts can be big, but the morphemes should be few.

Sentence Voice Problems

Our research has also told us something about how the "voice" used in a sentence affects readability/comprehensibility. The voice used in writing a sentence tells the reader about the relationship that exists between the subject and the verb of a sentence--what is happening and who or what is doing it. The research results indicate that the voice the writer chooses may help or hinder a reader's understanding of what he is trying to say. Let us look at three common voices used in writing English--the active, the passive, and the passive-negative. Here is an active sentence: "They found the boy sleeping on the floor." Here is a passive sentence: "The boy was found sleeping on the floor." Here is a passive negative sentence: "The boy was not found sleeping on the floor."

Most other researchers found that active sentences are easier to understand than passive sentences, and passive sentences are easier to understand than passive-negative sentences. We found no differences in difficulty between active and passive sentences, but we did find that passive-negative sentences are harder to understand than are either active or passive sentences. Furthermore, we found that the people we tested who were lower in reading ability had more trouble with passive-negative sentences than did people of better reading ability.

What do these findings indicate about how to choose sentences when you write? Primarily, they tell us that you should avoid using the passive-negative voice whenever possible. For example, the sentence "The capacitor was not found to have a proper resistor in series with it" could probably be understood easier if it read: "He did not find the capacitor to have the proper resistor in series with it."

It seems reasonable, also, to stick to the active voice, rather than to use the passive, whenever possible. This especially holds if it is possible that the reader would confuse the roles played by the subject and the object of the sentence. The active voice is less ambiguous. It avoids thought transpositions and reformulations. It is also a good idea to change a sentence like "The horse was seen by him to be running around the track" to read "He saw the horse running around the track." When you do this, you not only change the voice of the sentence but you "personalize" the sentence--you insert "He" in place of the impersonal "The." This helps the reader to understand the sentence better.

Negativity Problems

We have already noted that passive-negative sentences are harder to comprehend than either active or passive sentences. It seems that possibly the word "not" in these kinds of sentences is what often confuses the reader. As a matter of fact, any word or morpheme that denotes negativity will do the same. Accordingly, words with prefixes like "un," as in "unwise" or "dis," as in "disassemble," or "mis" as in "misrepresent" are more difficult to understand than positive words.

It seems that some "educated" people intentionally do this by talking like the professor in the cartoon. They hope to impress others with their pretentious "erudition" by "snowing" their audience.

Avoid phony erudition

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So, when you write, try to say things in as positive a way as possible. Rather than write "Do not disassemble the apparatus" write "Leave the apparatus assembled." In general, avoid the "un," "dis," "de," "mis" prefixes, as well as any other denoting negativity, unless they are absolutely essential for emphasis.

Self-Embedding

One other finding from our research on mental load and readability of written materials was the effect of "center-embedding" a sentence. A sentence is center-embedded when a clause is added between the subject and the predicate of the sentence. Here is a center-embedded sentence: "The president, having no intention of yielding to the repeated demands of the citizens, was forcing them to revolt." The underlined words show the subject and the predicate of the sentence's main clause. All of the other clauses are "embedded" between the subject--president-- and the predicate--was forcing.

Separating the subject and the predicate confuses the reader in regard to who is doing what. If you ever find that you have written an embedded sentence, here is how you can "de-embed" it. Do not separate the subject and the object with one or more phrases. Accordingly, the sentence in the prior example would be written as: "The president was forcing the citizens to revolt because he had no intention of yielding to their repeated demands." When you do this, you put the actor and the act itself in the sentence close together. This results in less confusion for your reader--you place a "lighter" mental load on him.

Here are some examples of self-embedded sentences; they are center-embedded from one to five clauses. Read them and you will see how to recognize if your own sentences are embedded:

a. The victim's family's lawyer demanded that the ransom be returned. (self-embedded by one clause)

b. The girl, having no heart, was allowing him to suffer. (self-embedded by two clauses)

c. The student, showing no promise of meeting the high expectations of his teachers, was forcing them to reconsider. (self-embedded by three clauses)

d. The president, having no intention of yielding to the repeated demands of the citizens, was forcing them to revolt. (self-embedded by four clauses)

e. The dragon, giving no evidence of surrendering under the numerous attacks of the knights who charged at him with a loud clash of swords, was forcing them to retreat. (self-embedded by five clauses)

Depth, Complements, and Branching

Some researchers have suggested that depth, complements, and branching are important in determining materials' readability. Sentence "depth" (the degree to which words are "buried" within a sentence) has been suggested to be of some importance in terms of readability. Here is a sentence of very low depth:

This car has four tires.

Here is a sentence that has a pretty high depth:

The new car which the neighbors bought and which has already been delivered, is a gift for their son who is graduating from college this semester.

The first sentence should be much easier to read and to understand than is the second sentence. Here is a way to make the second sentence lower in "depth" and thus more readable:

The new car has already been delivered.
It was brought by the neighbors as a gift for their son. He is graduating from college this semester.

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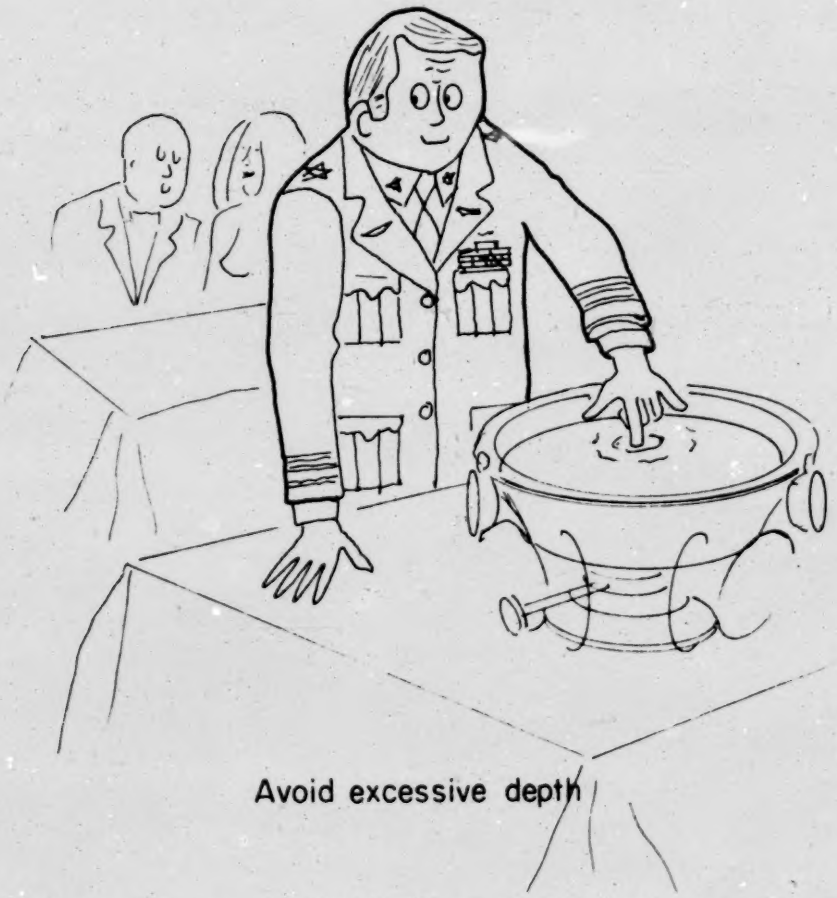
By breaking a long sentence like this into a number of shorter sentences, we can reduce "depth" and thus increase readability.



Avoid excessive depth

Some investigators have found that if a complement like the word "when" is deleted (left out) from a sentence, the sentence is harder to read. For example, the sentence "The man the dog bit died" is harder to understand than the sentence" The man whom the dog bit died." So, when you are writing a sentence like "John believed the girl was a fool" you can make it more readable if it were to read "John believed that the girl was a fool." When you do this, you help the reader to understand the true "message" of the sentence.

A right branching sentence is a sentence in which successive clauses are added to the right of the main clause as in this sentence "The umpire called a balk that the southpaw pitcher hit that the coach replaced." A left branching sentence is one in which successive clauses are added to the left of the main clause as in this sentence "The electricity powered toe chomping rock throwing lawn mower ran over its own cord." (The underlined words show the added clauses.) Most people have a hard time reading and understanding the right branching sentence but not the left branching sentence. You should avoid using right branching.

Helping the Reader's Intelligence to Work Easily

If reading materials are such that the reader must work very hard to understand what is being said, the reader will have less energy left for learning the concepts and the facts that are presented.

Deemphasize Vocabulary Diversity

Don't assume that the reader has a diverse vocabulary. Find the words you want and stick to them. Repeat them in your writing. Even if your reader has a diverse vocabulary, word repetition will make the text more comprehensible. Do not worry about finding synonyms for words--just use the same words over and over. The children's rhyme "One little piggy went to market, one little piggy stayed home" takes advantage of this. The rhyme, in its original form, is less mentally burdening than an alternate such as "One little piggy went to market, one diminuitive porkster stayed home."

Similarly, jargon and prestige terms are often substituted for good old fashioned English. These terms are included to show that the writer belongs to the proper "in group." Some writers keep a thesaurus on their desks in order that they can demonstrate their flexibility in word choice. Don't fall into this trap.

Ad-i-ad-o-cho-kin-e-sis
Is a term that will bolster my thesis
That 'tis idle to seek
Such precision in Greek
When confusion it only increases

(from English & English, 1958)

Linking Things Up for the Reader

Don't force your reader to make his own guess as to what goes with what or to form his own conclusions. Link related thoughts and state the conclusion when necessary. For example, if you were writing instructions for a base delivery man, you would not assume that he knows what to deliver and where to deliver it. If you want beer to go to the NCO club and milk to the commissary, you would not write "Deliver the beer and the milk to the NCO club and the commissary. That is, don't assume that the reader knows that the beer goes to the NCO club, but that the milk goes to the commissary. Tell him.

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Unstated linkages can be deceptive

Similarly, don't make any assumptions about what the reader knows or about the conclusions he will draw. Especially, don't assume that he should be able to "figure out for himself" things which logically follow from the information that you give him. If you write "The towns of Brown Mills and Pemberton are south of the base," don't assume that he'll figure out for himself that he has to go south to get to them. Tell him. This is easily accomplished through the use of such words as: therefore, accordingly, thus, it follows that, that is, consequently, and in other words.

Here is the way to tell if you have linked things up properly for your reader. Divide the number of sentences in your material by the number of incomplete hook-ups. Here is an example: "The firemen and the physicians rushed into the burning house. They pulled out their syringes and their hatchets." Who pulled out what? Maybe it is not obvious to some people that the physicians pulled out the syringes and the firemen the hatchets--here the writer failed to hook-up the two, so there are two incomplete linkages. There are two sentences and two incomplete linkages--2/2 = 100%. Writing which shows any evidence of an incomplete linkage should be reviewed and rewritten so as to remove the incomplete linkage. This organizes the thoughts and ideas for the reader and makes the learning easier.

Seeing Generalizations

Related to the problem of drawing conclusions from written material is the problem of generalization. Often the writer will state a rule or procedure and anticipate that the reader will be able to generalize to the many situations to which the rule will apply. Similarly, the writer may state a conclusion and anticipate that the reader will be able to draw the implications from the conclusion. Such generalization and implication drawing is very difficult for some people. It increases the mental burden imposed on the reader and slows the rate of learning.

For example, a writer of electronics principles material might write "The voltage in a circuit is equal to the product of the intensity of the current and the resistance of the circuit." Such a sentence would leave the reader to figure out the generalizations and implications which can be drawn from the statement. On the other

hand, if the writer had performed the required implication drawing for the reader, more learning would be likely to occur. For example, the writer could elaborate by the use of such sentences as: "Therefore, voltage can be increased by decreasing resistance or by increasing current intensity," "Accordingly, to obtain the intensity of the current, one would divide the voltage by the resistance," "On the other hand, decreasing either intensity or resistance decreases voltage," etc.

Here, again, the provision of the examples relieves the reader of the mental work involved in filling in the required implications and generalizations. Required order is provided and false generalizations are prevented. The full meaning of the principle is provided for the reader. Accordingly, the "so what?" feeling is eliminated, and perhaps most important, time is saved.

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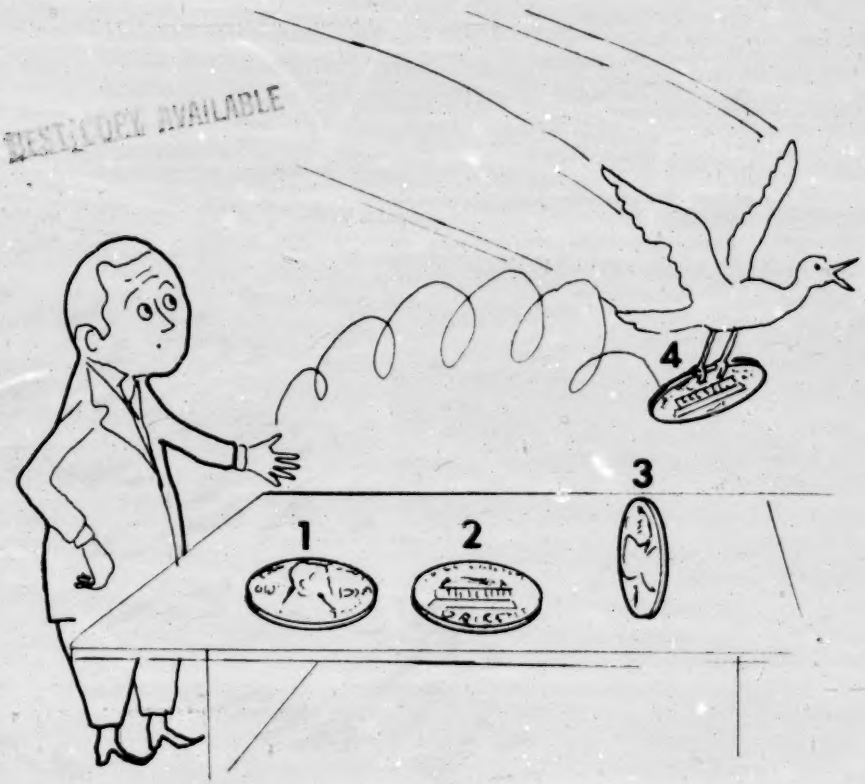
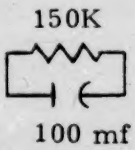


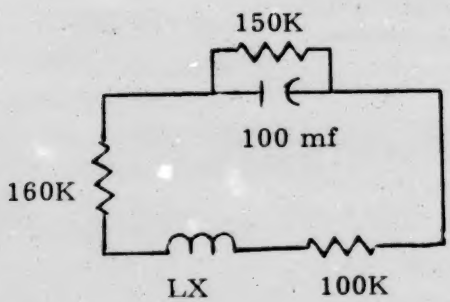
Show the implications

Cutting Down Unnecessary Details Presented in Figures and Diagrams

Where ideas are to be presented for learning by means of a figure, such as a map, a diagram of a machine, or a schematic of an electronics circuit, do not clutter your reader's mind with a log of unimportant details. Draw only what is absolutely necessary for him to learn the specific point. Otherwise, the reader may miss the forest because of the trees. For example, if he has the job of soldering a 100 microfarad capacitor to a one-hundred and fifty thousand ohm resistor, draw this:



not this:



Repeating Facts for your Reader

Be "redundant" in your writing--repeat the facts you want to get across to your reader. Try repeating them by writing them in a slightly different way. Example: "After you have tightened the three wing-bolts, attach the antenna. Tightening the three wing-bolts before antenna attachment simplifies later steps. If you fail to tighten the three wing-bolts before antenna attachment, the result will be..."

The way to determine just how redundant your material is would be simply to count the number of fact repetitions you have made. In the previous example, it is 3.00. If the fact repetition number is low relative to the number of facts presented, the comprehensibility of your text will probably suffer.

If you find that your writing has made frequent use of such words and phrases as: to repeat, in effect, accordingly, consequently, to reiterate, and in other words, your writing has to some extent achieved this memory unburdening goal. Remember that your goal is to transfer information to the reader--not to make him work hard.

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Repeat the facts

Organizing your Material

Try to provide memory aids for your reader. Give the reader's memory a helping hand. For example, to help beginners learn the musical staff, musicians introduced the memory aid (mnemonic) FACE. Some acronyms also qualify as memory aids:

RADAR - Radio and Ranging

Another example of a memory aid is found in Psalm 145. The first letter of each line forms the alphabet in sequence. Likewise, the jingle "Thirty days hath September..." is a valid example of a memory aid. A figure or picture which shows a process described in the text also qualifies as a memory aid. Here, we refer to figures which truly provide a memory assist and not to those which merely beautify.

If the writer places a burden on the reader's memory, the effort which the reader must exert increases. The motivation of the reader, who must now work harder to comprehend the writing, may decrease. If motivation decreases, learning decreases. Accordingly, the rule to remember is that the memory demands on the reader should be assisted or reduced wherever possible.

Avoid Abbreviations

Our research has shown us that the excessive use of abbreviations and contrived words is an especially disruptive influence on reading comprehension. The great writer George Orwell knew this, and in his novel ***Nineteen Eighty-Four*** he tells us of his appreciation of the fact that the excessive use of abbreviation, acronyms, and the like can even be used to paralize our ability to think clearly. Here is an example from Orwell:

> Scattered about London there were just three other buildings of similar appearance and size. So completely did they dwarf the surrounding architecture that from the roof of Victory Mansions you could see all four of them simultaneously. They were the homes of the four Ministries between which the entire apparatus of government was divided: the Ministry of Truth, which concerned itself with news, entertainment, education, and the fine arts; the Ministry of Peace, which concerned itself with war, the Ministry of Love, which maintained law and order; and the Ministry of Plenty, which was responsible for economic affairs. Their names, in Newspeak: Minitrue, Minipax, Miniluv, and Miniplenty.
>
> The Ministry of Love was the really frightning one. There were no windows in it at all. (Emphasis ours, p.6)

As Orwell later notes, the use of this kind of language is "... designed not to extend but to diminish the range of thought..." (p. 304). A writer's job is to extend his reader's knowledge; to do so, avoid writing which employs excessive or unnecessary abbreviations and acronyms.

Here is a way of determining if you have too many abbreviations in your writing. Count the number of words in your sentence and then count the number of abbreviations and/or contrived words in it. Put the former in the denominator and the latter in the numerator of a ratio. The smaller the numerator, relative to the denominator, the easier your material is.

If you follow the suggestion outlined above, you will make your writing easier for your reader to understand.

CHAPTER II

MEASURING READABILITY

We have attempted to suggest some ways of writing that make material more readable and comprehensible. This chapter describes some methods for determining how readable already written material is.

There are a number of methods which can be used to measure the readability of the text you write. The Air Force Human Resources Laboratory is also performing research which will provide new and improved measures of readability/comprehensibility. These new methods will be fully extended so that the comprehensibility of any text can be calculated through digital computer methods. Additionally, the new methods will be diagnostic. That is, they will tell a technical writer how to improve his writing as well as how comprehensible a given piece of material is. The older methods, which are described below, do not possess this feature.

The Use Test

The use test is appropriate for testing manuals and other procedural guides. In the use test, persons having a background which is similar to the background of the eventual users of textual materials are asked to employ the written materials in "real-life" situations. The users are observed, their errors are noted, and a score is derived. This score is then used as a measure of the material's ability to get its message across to the reader.

To use this procedure, you need: (a) a group of persons who are representative of the users of your manual, and (2) a set of the real-life situations that your manual is to be used with.

The group of persons is asked to use the manual to perform the tasks. Errors are noted, scores are derived, and the written materials are revised so as to minimize the future occurrence of these errors. The sample of users may also be questioned about any areas of confusion introduced by the text. Comparison of scores of groups on the test "before" and "after" revision indicates the extent of improvement brought about by the revision. The advantage

of the use test is that it possesses high face validity. The disadvantages of the use test involve its high cost and the fact that in this procedure the final score confounds technical inability to perform with unreadability of materials.

The Comprehension Test

The comprehension test approach parallels that of the use test and represents a written examination which is administered to a group of people (sample) which is representative of the ultimate readers of the material. First, the group is asked to read the material. Then the test is administered. You can also administer this test as an "open book" test. If you want to use this method, you will need: (1) a group of would-be manual users, and (2) a prepared test which is based on the specific messages you want to get across.

After test administration and scoring, the textual materials are revised in accordance with areas of low comprehensibility, as indicated by poor scores on the test.

The advantage of this method of testing readability is that it is relatively inexpensive to apply. Its disadvantages involve the fact that the writing may be acceptable but the test may be poor. Also, unless comprehension tests of equivalent difficulty can be constructed, the possibility of making comparisons across different manuals is ruled out.

Rating by Experts

In the rating by experts technique, a number of experts on the subject matter about which you have written are asked to examine and read your material and to estimate its understandability in comparison with other materials or on some other basis.

If you wish to use this approach, you will need: (1) a group of people who are considered to be experts on the subject matter under consideration, and (2) a group of materials against which the experts can compare a representative sample of your materials.

The materials should cover the range of "acceptable" through unacceptable." The experts are asked to state the comparison text which is closest to the text under consideration. Text portions receiving low readability/comprehensibility ratings are then rewritten. The disadvantages of this technique concern the problems that can arise in the selection of the experts and in the criterion material, as well as in generalization from the expert opinion to the user population.

The "Cloze" Procedure

The "cloze" procedure yields a measure of the "commonality between the total language system of the author and the reader" [Osgood, 1959, p. 81]. Here, words are left out of a passage of written material, and the reader fills these gaps with words that make the most sense to him. The degree to which you, as the writer, use words that the reader expects and understands will determine the ease with which he can successfully fill in the correct words.

To use the cloze procedure, the gaps are made by leaving out certain words of the text; the cloze score indicates the extent to which a reader can reproduce the original "sense" of the material after it has been "broken up." High cloze scores show that good reproduction of the original "sense" has been made, and a low cloze score tells us that the readability of a passage has suffered as the result of leaving out the words.

In order to employ this procedure, you need: (1) short (250 word) selections from your written material, and (2) a systematic leaving out of certain words from the passages (for example, every fifth word). The broken-up copy of the passages is presented to a group who are representative of the ultimate readers; this group is asked to fill in the missing words. The result is a cloze score (average number of correct fill ins). The higher this score, the more readable your writing is. As with the other methods, sections with low scores are rewritten and, if necessary, retested. The cloze procedure possesses a number of advantages over other methods of measuring readability of technical manuals. These advantages include

the facts that: cloze does not penalize the technical publication as do Flesch and similar counting procedures, cloze seems to measure desirable redundancy in the prose, and finally, the method may be administered by persons who have little special training in test development and administration. The disadvantages of the cloze method is that, because norms are unavailable, one doesn't know what the most desirable close score level is.

Element Counting Techniques

Some of the most common and popular methods of determining the readability of written materials are based on element counting techniques. Among these methods are Flesch counts and the Dale-Chall technique. These techniques are based on such factors as the length of the sentences in the materials and on the familiarity of the words used in the writing. The use of these element counting procedures involves: (1) getting together a representative collection of your written materials, (2) making the appropriate sentence length, word length, etc., counts, and (3) entering a set of tables which reference the score obtained by the textual materials under consideration to standard materials.

There is, however, a problem with these techniques when we apply them to technical material (material which you, as an Air Force technical writer, will most probably be involved with). Technical terminology, although uncommon by general standards, is common to people working within a particular specialty. Thus, technical material may be more interesting to the subject matter specialist, even though it may be of little or no interest to a layman who does not understand or use the technical terminology.

If You Want More Details on Readability Measurement

The Air Force Human Resources Laboratory is presently publishing a complete review, description, and analysis of the older methods for testing the readability/comprehensibility of text. The report titled ***Readability of textual material: A survey of the literature*** will soon become available. You should find this report to be of interest if you wish to test the readability of your

writing. Finally, there are a number of technical and procedural matters involved in using these techniques. An expert in the field should be consulted before attempting to use them. Here is a list of selected readings on readability which you might wish to consult:

Application of Structure-of-Intellect and psycholinguistic concepts to reading comprehensibility measurement. A.I. Siegel and J.R. Burkett (Eds.), in press.

The effects of reading difficulty, literacy level, and method of presentation on comprehension of training materials. M.R. Lautman, A.I. Siegel, A.R. Williams, and J.R. Burkett, Air Force Human Resources Laboratory, Technical Report, Lowry Air Force Base, Colorado, in press.

Increasing and evaluating the readability of Air Force written materials. A.I. Siegel, P.J. Federman, and J.R. Burkett, in press.

All of these reports were written for the Technical Training Division, Air Force Human Resources Laboratory, Air Force Systems Command, Lowry AFB, Colorado. Additionally, the following two reports might be of interest:

Normative development for submarine sonar manuals. P.J. Federman, D.H. Macpherson, and A.I. Siegel, Prepared by Applied Psychological Services, Inc., Wayne, Pa., for the Sonar Technology Division, Naval Ship Systems Command, Department of the Navy, Engineering and Psychology Branch, Psychological Science Division, Office of Naval Research, 1970, under Contract N00014-67-C-0450.

New techniques for measuring and improving reading comprehension. R.P. Carver, Washington: American Institute for Research, 1973.

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